

CLAIMS

What is claimed is:

1. A system for cutting a bone at a desired location, including:

5 a drill cylinder having a body that defines a central bore, and an element configured to be detected by an image guidance system to permit image guidance of the drill cylinder to a target location on the bone; and

a cutting block having

a frame,

10 a first guide adjustably connected to the frame,

a first adjustor connected to the frame, and

15 a first mounting location defined by the frame and configured to attach to the bone at the target location,

the first guide defining a first cutting path having a position, the position of the first cutting path relative to the first mounting location being adjustable using a grip of the first adjustor.

20 2. The system of claim 1, wherein the drill cylinder includes a handle connected to the body and configured to permit manual positioning of the body.

25 3. The system of claim 1, wherein the drill cylinder includes an array of elements configured to be detected by the image guidance system.

4. The system of claim 1, wherein the cutting block frame includes a plurality of channels configured to support the first guide and accommodate movement of the first guide during adjustment of the first cutting path.

25 5. The system of claim 1, wherein the first guide includes a pair of substantially parallel guide walls extending between a pair of end portions, the guide walls and the end portions defining the first cutting path.

6. The system of claim 1, wherein the first mounting location includes a bore defined by the frame.

30 7. The system of claim 1, wherein the frame defines a second mounting location, the first mounting location and the second mounting location being located on an attachment wall of the frame.

8. The system of claim 1, wherein the frame further includes a mounting plate coupled to the frame to accommodate linear adjustment of the position of the first cutting path.

5 9. The system of claim 8, wherein the mounting plate is further configured to accommodate angular adjustment of the first cutting path.

10 10. The system of claim 9, wherein the mounting plate includes an arcuate channel for supporting a post connected to the first guide, the arcuate channel defining a path of angular adjustment of the first cutting path.

11. The system of claim 1, wherein the cutting block further includes a second guide defining a second cutting path having a position, the position of the second cutting path relative to the first mounting location being adjustable.

15 12. The system of claim 11, wherein the position of the second cutting path relative to the first mounting location is adjustable using a second grip of the first adjustor.

13. The system of claim 12, wherein use of the second grip causes linear adjustment of the position of the second cutting path.

14. The system of claim 13, wherein the cutting block further includes a second adjustor having a grip, use of the second adjustor grip causing angular adjustment of the position of the second cutting path.

20 15. The system of claim 11, wherein the position of the second cutting path relative to the first mounting location is adjustable using a grip of a second adjustor.

16. The system of claim 1, wherein the frame includes a first end wall, a second end wall, a first side wall extending between the end walls, and a second side wall extending between the end walls.

25 17. The system of claim 16, wherein the first guide is connected between the side walls adjacent the first end wall.

18. The system of claim 17, wherein the cutting block further includes a second guide defining a second cutting path, the second guide being adjustably connected to the frame between the side walls.

19. The system of claim 18, wherein the cutting block further includes a third guide defining a third cutting path, the third guide being adjustably connected to the frame between the side walls.

5 20. The system of claim 19, wherein the cutting block further includes a fourth guide defining a fourth cutting path, the fourth guide being adjustably connected to the frame between the side walls adjacent the second end wall.

21. The system of claim 20, wherein the second guide and the third guide are positioned between the first guide and the fourth guide.

10 22. The system of claim 21, wherein the second guide is positioned between the first guide and the first mounting location and the third guide is positioned between the fourth guide and the first mounting location.

23. The system of claim 1, wherein the position of first guide is adjustable linearly relative to the first mounting location using the first adjustor.

15 24. The system of claim 20, wherein the cutting block further includes a second adjustor, a third adjustor, and a fourth adjustor, the first guide and the second guide being adjustable linearly relative to the first mounting location using the first adjustor, the second guide being adjustable angularly relative to the first mounting location using the second adjustor, the third guide and the fourth guide being adjustable linearly relative to the first mounting location using the third adjustor, and the third guide being adjustable angularly relative to the first mounting location using the fourth adjustor.

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25 25. The system of claim 1, further including a tracking instrument having an engagement portion and an element configured to be detected by the image guidance system to permit image guidance of adjustments of the first cutting path relative to the first mounting location when the engagement portion is placed in engagement with the first cutting path.

26. The system of claim 25, wherein the tracking instrument includes a plurality of elements configured to be detected by the image guidance system.

30 27. The system of claim 25, wherein the engagement portion includes a plate configured to fit within the first cutting path.

28. The system of claim 25, wherein the engagement portion includes a tip positioned at an end of the tracking instrument that is substantially opposite the element.

29. A system for locating a planar cut through a portion of a bone,
5 including:

an image guided drill cylinder having a body that defines a central bore configured to receive one of a drill bit and a pin, and a tracking element coupled to the body;

10 a receiver configured to sense a present location of the tracking element and provide location signals representing the present location of the tracking element;

15 a processor coupled to the receiver, the processor being configured to receive the location signals and to determine, based upon the location signals and data representing a target location on the bone, a present location of the central bore relative to the target location;

a display coupled to the processor, the display being configured to generate images representing the present location of the central bore relative to the target location so that the drill cylinder may be moved until the present location of the central bore registers with the target location; and

20 a cutting block having a frame including a first mounting location configured to connect the cutting block to the bone at the target location, and a first guide adjustably mounted to the frame for movement relative to the first mounting location, the first guide defining a first cutting path adapted to guide a saw for creating the planar cut when the first guide is adjusted such that the first cutting path is in a position corresponding to the planar cut.

25 30. The system of claim 29, wherein the cutting block frame includes a pair of channels positioned to support the first guide during adjustment of the first cutting path.

31. The system of claim 29, wherein the first guide includes a pair of
30 guide walls substantially defining the first cutting path.

32. The system of claim 29, wherein the frame defines a second mounting location, the first mounting location and the second mounting locations being located on an attachment wall of the frame.

5 33. The system of claim 29, wherein the frame further includes a mounting plate coupled to the frame to accommodate linear adjustment of the position of the first cutting path.

34. The system of claim 33, wherein the mounting plate is further configured to accommodate angular adjustment of the first cutting path.

10 35. The system of claim 29, wherein the cutting block further includes a second guide defining a second cutting path having a position, the position of the second cutting path relative to the first mounting location being adjustable.

36. The system of claim 35, wherein the cutting block further includes a second adjustor having a grip, use of the second adjustor grip causing angular adjustment of the position of the second cutting path.

15 37. The system of claim 35, wherein the cutting block further includes a second guide defining a second cutting path, the second guide being adjustably connected to the frame, a third guide defining a third cutting path, the third guide being adjustably connected to the frame, and a fourth guide defining a fourth cutting path, the fourth guide being adjustably connected to the frame.

20 38. The system of claim 37, wherein the second guide is positioned between the first guide and the first mounting location and the third guide is positioned between the fourth guide and the first mounting location.

39. The system of claim 37, wherein the first guide is adjustable linearly relative to the first mounting location using a first adjustor having a grip.

25 40. The system of claim 39, wherein the cutting block further includes a second adjustor, a third adjustor, and a fourth adjustor, the first guide and the second guide being adjustable linearly relative to the first mounting location using the first adjustor, the second guide being adjustable angularly relative to the first mounting location using the second adjustor, the third guide and the fourth guide being adjustable linearly relative to the first mounting location using the third

adjustor, and the third guide being adjustable angularly relative to the first mounting location using the fourth adjustor.

41. The system of claim 29, further including a tracking instrument having an engagement portion and an element configured to be detected by the receiver to permit image guidance of adjustments of the first cutting path relative to the first mounting location when the engagement portion is placed in engagement with the first cutting path.

5 42. The system of claim 41, wherein the engagement portion includes a plate configured to fit within the first cutting path.

10 43. A method of cutting a bone, including the steps of:
image guiding a drill cylinder to a first target location on the bone, the first target location corresponding to a predetermined first position of a first mounting location of a cutting block;
securing the first mounting location to the first target location;
15 adjusting a position of a first cutting path of the cutting block relative to the first mounting location; and
moving a cutting instrument along the first cutting path to cut the bone.

20 44. The method of claim 43, wherein the adjusting step includes the step of positioning an image guided tracking instrument in engagement with the first cutting path.

45. The method of claim 43, further including the step of image guiding the drill cylinder to a second target location on the bone, the second target location corresponding to a predetermined second position of a second mounting location of the cutting block.

25 46. The method of claim 45, further including the step of securing the second mounting location to the second target location.

47. The method of claim 43, wherein the adjusting step includes the step of actuating a first adjustor to cause linear movement of the first cutting path relative to the first mounting location.

48. The method of claim 47, wherein the adjusting step includes the step of actuating a second adjustor to cause angular movement of the first cutting path relative to the first mounting location.

5 49. The method of claim 43, further including the step of repositioning the cutting block relative to the first target location.

50. The method of claim 49, wherein the repositioning step includes the steps of placing the drill cylinder at a second mounting location on the cutting block and image guiding the drill cylinder and the cutting block until the second mounting location registers with a second target location on the bone.

10 51. The method of claim 43, wherein the adjusting step is performed before the image guiding step.

52. The method of claim 43, wherein the securing step includes the steps of drilling a bore into the bone and inserting a pin into the bore.

15 53. The method of claim 52, wherein the inserting step includes the step of inserting the pin percutaneously into the bore.

54. The method of claim 43, wherein the image guiding step includes the step of placing the drill cylinder percutaneously onto the first target location.

20 55. The method of claim 43, further including the step of adjusting a position of a second cutting path of the cutting block relative to the first mounting location.

56. The method of claim 55, further including the step of adjusting a position of a third cutting path of the cutting block relative to the first mounting location.

25 57. The method of claim 56, further including the step of adjusting a position of a fourth cutting path of the cutting block relative to the first mounting location.

58. The method of claim 43, further including the step of positioning an image guided tracking instrument in engagement with the cut on the bone to verify the location of the cut.

30 59. The method of claim 58, further including the step of positioning the image guided tracking instrument in engagement with the first cutting path to

adjust the location of the first cutting path based upon the verification of the location of the cut.

60. A cutting block configured to guide a cutting instrument during a bone cutting procedure, including:

- 5 a frame;
- a first mounting location defined by a portion of the frame;
- a first guide coupled to the frame, the first guide including a first surface defining a first cutting path;
- 10 a second guide coupled to the frame, the second guide including a second surface defining a second cutting path;
- a first adjustor coupled to the first guide, the first adjustor including a first grip configured to permit a user to actuate the first adjustor, thereby causing linear movement of at least a portion of the first cutting path relative to the first mounting location; and
- 15 a second adjustor coupled to the second guide, the second adjustor including a first grip configured to permit a user to actuate the second adjustor, thereby causing angular movement of the second cutting path relative to the first mounting location.

61. The system of claim 60, wherein the frame includes a first pair of channels configured to support the first guide and accommodate movement of the first guide during adjustment of the first cutting path, and a second pair of channels configured to support the second guide and accommodate movement of the second guide during adjustment of the second cutting path.

62. The system of claim 60, wherein the first guide includes a guide wall extending between a pair of end portions, the first surface being disposed on the guide wall.

63. The system of claim 60, wherein the frame defines a second mounting location, the first mounting location and the second mounting locations being located on an attachment wall of the frame.

64. The system of claim 60, wherein the frame further includes a mounting plate coupled to the frame to accommodate linear adjustment of the position of the second cutting path relative to the first mounting location.

5 65. The system of claim 64, wherein the mounting plate includes an arcuate channel configured to accommodate angular adjustment of the second cutting path.

66. The system of claim 60, wherein the position of the second cutting path relative to the first mounting location is adjustable using a second grip of the first adjustor.

10 67. The system of claim 66, wherein use of the second grip causes linear adjustment of the position of the second cutting path.

68. The system of claim 60, wherein the frame includes a first end wall, a second end wall, and a pair of substantially parallel side walls extending between the end walls.

15 69. The system of claim 68, wherein the cutting block further includes a third guide defining a third cutting path, the third guide being adjustably connected to the frame between the side walls.

70. The system of claim 69, wherein the cutting block further includes a fourth guide defining a fourth cutting path, the fourth guide being adjustably connected to the frame between the side walls adjacent the second end wall.

20 71. The system of claim 70, wherein the second guide is positioned between the first guide and the first mounting location and the third guide is positioned between the fourth guide and the first mounting location.

72. A system for cutting a bone at a desired location, including:

25 a drill;
an element attached to the drill and configured to be detected by an image guidance system to permit image guidance of a drill bit connected to the drill to a target location on the bone; and

a cutting block having

30 a frame,
a first guide adjustably connected to the frame,

a first adjustor connected to the frame, and
a first mounting location defined by the frame and configured to
attach to the bone at the target location,

the first guide defining a first cutting path having a position, the
position of the first cutting path relative to the first mounting location being
adjustable using a grip of the first adjustor.

73. A system for locating a planar cut through a bone, including:

means for image guiding a drill to create a bore in a target location of the
bone;

means for providing a cutting path to guide a saw for creating the planar
cut;

means for mounting the providing means to the bone at the target
location;

means for image guiding the providing means; and

means for adjusting a position of the providing means relative to the
mounting means.